Endegena Asfaw
Ilari Tuokoniitty

Infection Statistics in Hemodialysis Unit of Helsinki University's Surgical Hospital in the years 2007-2010

Helsinki Metropolia University of Applied Sciences
Degree Programme in Nursing
Bachelor of Healthcare
Final Project
20.02.2012

Helsinki Metropolia University of Applied Sciences

Degree Programme in Nursing and Health Care	Degree Bachelor of Health Care

Author/Authors
Endegena Asfaw and Ilari Toukoniitty

Title

Infection Statistics in the Hemodialysis Unit of Helsinki University's Surgical Hospital in the years 2007-2010.

Type of Work	Date	Pages
Final Project	Autumn 2011	26 + 4 liitettä

ABSTRACT

Hemodialyysi on elintärkeä hoitokeino ihmisille jotka kärsivät loppuvaiheen munuaissairaudesta HUS Kirurgisen sairaalan Nefrologian klinikalla.

Tämän opinnäytetyön tarkoitus on kuvata infektio tilastoja vuodesta 2007 vuoden 2010 loppuun kirurgisen sairaalan hemodialyysi osastoilla, ja samalla syventää ymmärrystä hemodialyysiin liittyvistä infektioista ja riskeistä niihin liittyen.

Metodina on käytetty kuvailevaa tilastoanalyysiä jolla määrällisesti kuvaamme infektioiden määrää pohjaten niihin tilastoihin jotka sairaalalta saimme.

Tuloksista käy ilmi, että infektiot ovat laskeneet vuodesta 2007 vuoteen 2010, mutta kaavioita tarkasteltaessa eri vuosilta käy ilmi infektiomäärien tasaisuus, lukuunottamatta muutaman infektiotyypin suurta vaihtelua eri vuosina.

Infektioiden torjunnan painotus käytännössä, ja konkreettiset toimenpiteet ovat hyvin tärkeitä bakteereiden, viruksien ja taudinaiheuttajien leviämisen minimoimiseksi. Asianmukaisten infektion hallinta ohjeiden noudattaminen on olennaista infektioiden minimoimiseksi, ja näitä tulisi noudattaa poikkeuksetta.

Avainsanat
Infektio, aseptiikka, käsihygienia, hemodialyysi.

Helsinki Metropolia University of Applied Sciences

Degree Programme in Nursing and Health Care	Degree Bachelor of Health Care

Author/Authors
Endegena Asfaw and Ilari Toukoniitty

Title
Infection Statistics in the Hemodialysis Unit of Helsinki University's Surgical Hospital in the years 2007-2010.

Type of Work	Date	Pages
Final Project	Autumn 2011	26 + 4 appendices

ABSTRACT

Hemodialysis continues to be an important treatment option for individuals with end stage renal disease (ESRD) in the Nephrology Clinic of the Helsinki University City Hospital. The purpose of this final project was to describe the infection statistics from the years 2007 to 2010 in surgical hospital in a hemodialysis unit.

The method used was descriptive statistics, which was applied for describing quantitatively the infection statistics of the data we had collected from the hospital.

The findings in this study showed that the total number of infections during the four years from 2007 to 2010 in the nephrology dialysis ward was higher compared to the dialysis training ward.
Emphasis on the importance of more infection control measures should be taken into account to minimize the transmission of bacteria, virus or disease. As we have observed from the graphs, the patients in the hemodialysis center seem to be more susceptible to infections compared to the dialysis training center. The proper adherence to infection control guidelines is essential in minimizing infection and should be followed by health care personnel.

Keywords
Infection, asepsis, hand hygiene, hemodialysis.

CONTENTS

1. INTRODUCTION

Nosocomial infections are the most common adverse event experienced by hospitalized patients. More recent data suggest that 10 % of patients develop a nosocomial infection during admission to an acute care hospital. Hospital-acquired infections (HAI) increase morbidity, extend hospital stays, and increase hospital charges. They are also associated with substantial increases in in-hospital mortality. (Coffin & Zaoutis 2005:647-665.) For example, infection is the second leading cause of death among dialysis patients. It has shown to account for about 33 deaths per 1000 patients per year in the prevalent US Renal Data System (USRDS) cohort for 2001 through 2003 (Aslam et al. 2006:1226-1233).

Our project was a joint project of the Metropolia University of applied sciences and Helsinki University surgical hospital. This nephrology hospital comprises of two dialysis units. The first one is an educational dialysis center, where patients get proper education on how to dialysis themselves at home, and this is planned to decrease frequent hospital visits. The second one is a basic inpatient dialysis unit. Thus, the purpose of this final project was to describe the infection statistics from the year 2007 to 2010 in a hemodialysis unit. The topic was selected based on its relevance to the nursing field and health care.

According to the statistics of Finnish Registry of Kidney Disease (2008), over the last 10 years (1998-2008) the number of people going for hemodialysis has increased by 80% in Finland and due to this fact there is an increasing risk of infection. Besides, from the statistics center of diseases control (2003), there is a higher chance of person-to-person transmission of infectious where many patients receive dialysis regularly. Hemodialysis patients need frequent hospitalization. As a result there is an increase in their chances of exposure to nosocomial infections. For the above- mentioned reasons, the topic was interesting for us to explore and gain more knowledge about the asepsis, infection control and dialysis. While working on this project, we got definitely opportunities to gain more knowledge about dialysis and the importance of asepsis in the hemodialysis unit. Consequently, we developed confidence and acquired skills that help in similar work environments where we will apply our knowledge that we gained in this project on caring for patients.

2. KEY CONCEPTS

Nephrology nursing is a distinct specialty area of nursing which has evolved in response to the complex health care required for people with renal failure (Parker 1998: 5-23). According to Bonner and Walker (2003: 210-218), nephrology nursing encompasses a number of subspecialty areas including general nephrology, hemodialysis, peritoneal dialysis and renal transplantation units.

2.1 Infection

An infection is an invasion of body tissue by microorganisms and their proliferation. Such a microorganism is called an infectious agent. If the microorganism produces no clinical evidence of disease, the infection is called asymptomatic. Four major categories of microorganisms cause infection in humans: bacteria, viruses, fungi, and parasites. (Kozier, Erb, Berman & Snyder 2004:629-630.)
According to Stucke (1993: 38-39), the factors essential to the process of infection are:

- Pathogenic organism
- Susceptible host (allowing the pathogen to enter and multiply), and
- Means of transmission (exit and transference)

An understanding of how an infection can be transmitted and how transmission risks can be reduced will help the nurse take appropriate action when caring for infected and at risk patients. Knowledge of the sources of potential infection and the body mechanisms for fighting infection will enable the nurses to maintain a positive approach to health and to avoid infection in themselves, their patients and their fellow workers.

Patients with chronic hemodialysis are at high risk for infection because of impaired immune defenses, a high severity of illness, and the need for routine puncture of a vascular access site to remove blood for hemodialysis. Vascular access sites may consist of fistulas (created from the patient's native vessels), grafts (created with synthetic material), and cuffed (permanent) or noncuffed(temporary) catheters. Of these, the risk of infection is highest for catheters, intermediate for grafts, lowest for fistulas. (Tokars, Miller & Stein 2002:288-295.)

Infections in patients undergoing hemodialysis have adverse consequences for the individual patient, including increased morbidity and mortality, and for the society, including increased costs, hospitalization rates, and need for antimicrobials. (Tokars, Miller & Stein 2002:288-295.)

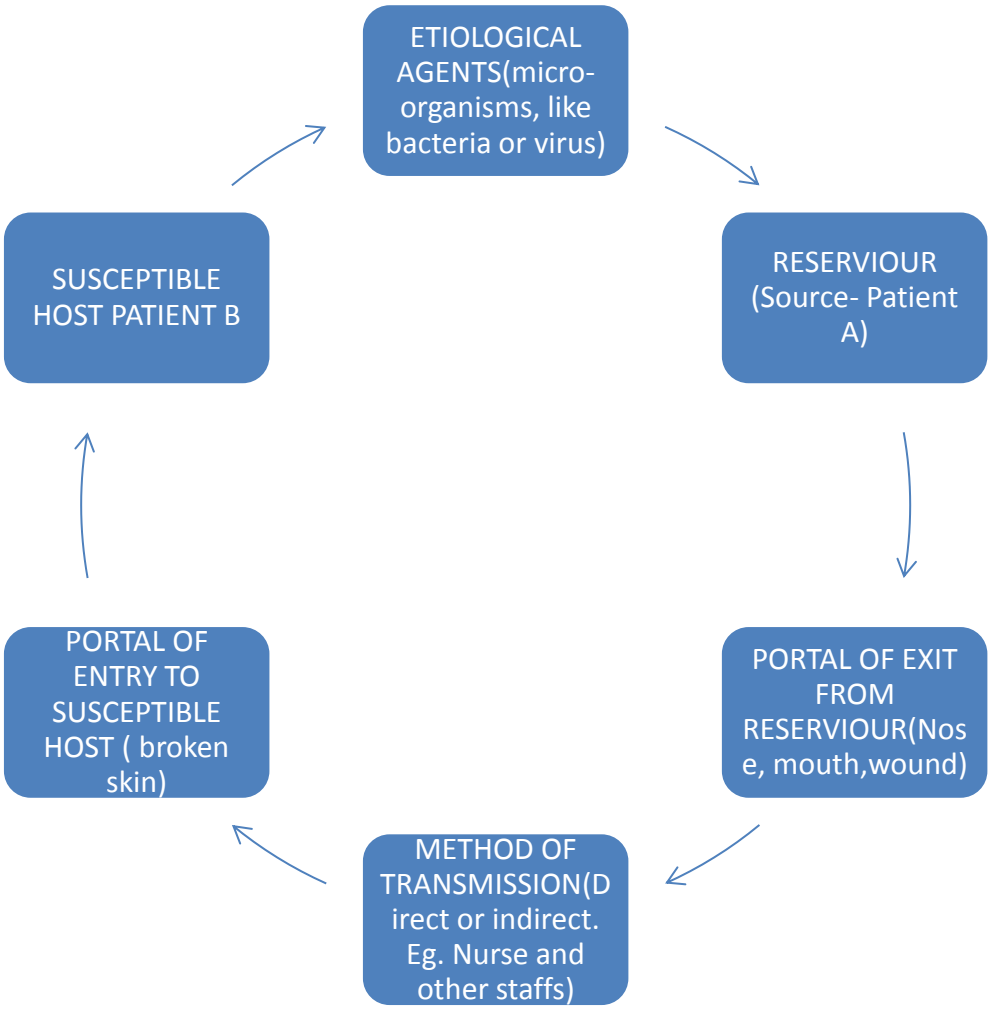

Figure 1: Chain of Infection

*Source: Adapted from Kozier and Erb 2004:632

2.2 Asepsis

Asepsis is the state of being free from disease-causing microorganisms. To decrease the possibility of transferring microorganisms from one place to another, asepsis is used. There are two basic types of asepsis: medical and surgical. (Duval 2010:485-489; Kozier 2004:630.) Hand washing, disinfecting contaminated surfaces and cleaning in general are part of medical asepsis but these procedures are not fully sterile. Medical asepsis can kill microorganisms but not their spores. For instance, skin cannot be sterilized or disinfected. Surgical asepsis is a sterile technique which includes practices that destroy all microorganisms and spores; this is performed by the health professionals using different precautions than in medical asepsis. Surgical asepsis is carried out to prevent organisms from entering the body during an invasive procedure. Thus, all equipment used in this process is sterilized. As a result this procedure is fully sterile.

According to Berns and Tokars (2002: 886-898) materials such as instruments, needles, gloves and solutions that come in contact during hemodialysis must be clean and disinfected. Asepsis also requires that the staff and anyone else visiting the ward follow the proper procedures of hand hygiene and protection in order to avoid carrying of pathogens from outside to the ward. In this way both the staff and the patients are protected from infections. It is important that the nurse's knowledge of the infection process, application of infection control principles and the use of common sense help to protect patients from infection.

Asepsis includes disinfection which reduces the number of microorganisms. Disinfectants chemicals are used where possible to achieve sterile conditions such as soap for hand washings, disinfection liquids used after hand washing and whenever possible before and after contact with a patient. The most common disinfectants, alcohol and chlorhexidine, are mostly used on the hands and phenolic disinfectants for cleaning surfaces . Thus, good aseptic technique is indispensable to minimize infection and promote healing. It is imperative that health professionals working in hemodialysis unit are proficient in this skill and understand the theory behind it. (Bakke 2010:601-616; Birchenough, Moore, Stevens & Stewart 2010:491-499,555; Ingram & Murdoch 2009:49-57.)

2.3 Hand hygiene

Health care associated infections are a worldwide problem and these infections may occasionally lead to a patient's death. There is a clear connection between poor hand hygiene and infections. Hand hygiene is a complex issue nowadays. Despite of many proven studies, the hand hygiene compliance is still low in the field of health care setting (Boyce & Pittet 2002: 1-4). Different technique method used to improve the quality of hand hygiene, but still the implementation of hand hygiene to the healthcare workers is very minimal. This is why a hand hygiene issue is evoking for the healthcare workers and for the nursing students.

The Centers for Disease Control 2011 confirmed that hand hygiene practice decreases nosocomial infections (Trunnell & White 2011:80). Besides, it is a simple and important procedure to reduce the spread of infections in the health care environment. Furthermore, it is a part of Standard Precautions Guidelines of the Center for Disease and Control Prevention. (Siegel, Rhinehart, Jackson & Chiarello 2007:49.) The hand of a health care worker is a very important instrument during patient care. Best hand hygiene practice and applying it properly is a part of good quality care and safety during the treatment.

When taking care of a hemodialysis patient, it is important to pay attention to increased sensitivity to infections because these potential infections may further weaken the patients' state. Patient safety can be improved by executing hand hygiene in a proper way. Hand hygiene is an important, economic and easy procedure for the prevention of hospital acquired infections. It is a term that refers to hand washing, hand rub disinfection and surgical hand washing. Hand hygiene is the simplest intervention to prevent the cross infection of micro bacteria and it decreases the incidence of health care associated infection within the community. (Kac et al.2005:32-39,60.)

2.4 Hemodialysis

Dialysis is a mechanical process that performs the work of healthy kidneys. Hemodialysis uses an artificial membrane (dialyzer) to remove wastes and extra fluid from the blood. It also restores proper electrolyte balance in the blood. The fluid used to filter or clean the blood is called dialysate. Hemodialysis is usually done in a hospital or dialysis center. In hemodialysis, an access is made for the dialysis, which then carries the blood to and from the dialysis machine. A fistula between an artery and a vein in the forearm is made. Another option is to use a graft to connect the artery and a vein. In some cases a central venous catheter is used. (Brunner & Suddarth 2008 :1537-1539.)

According to the National Kidney Foundation, one important step before starting regular hemodialysis sessions is preparing a vascular access, which is the site on your body where blood is removed and returned during dialysis. To maximize the amount of blood cleansed during hemodialysis treatments, the vascular access should allow continuous high volumes of blood flow. Thus, for hemodialysis patients, the access is one of the following:

A fistula is an access made by joining an artery and vein in the patient arm. This method is most effective and most durable method because the chances of blood clotting are rare. Fistula is made by joining one of the arteries to one of the vein in a lower arm which takes 6 to 12 weeks to form. Although a fistula allows repeated access for each dialysis session, it has complications such as infections at the access site and blood clotting.

A graft is an access made by using a piece of soft tube to join an artery and vein in the patient arm. Again, in this case, a synthetic tube is planted under the skin in an arm to produce a vascular access known as a graft. This tube acts as an artificial vein for the use of needle and passage for the blood during the hemodialysis process. This method is usually adopted when patients have small veins. A graft can be used right after one week of plantation, however it can create more clotting and infections problems. Therefore it should be replaced sooner.

A catheter is a soft tube that is placed in a large vein. This is usually placed in the neck, chest and groin of the patient for temporary use when a patient who does not have any

permanent access or until the permanent access develops. Blood clotting and infection chances are higher; therefore, it cannot be used routinely.

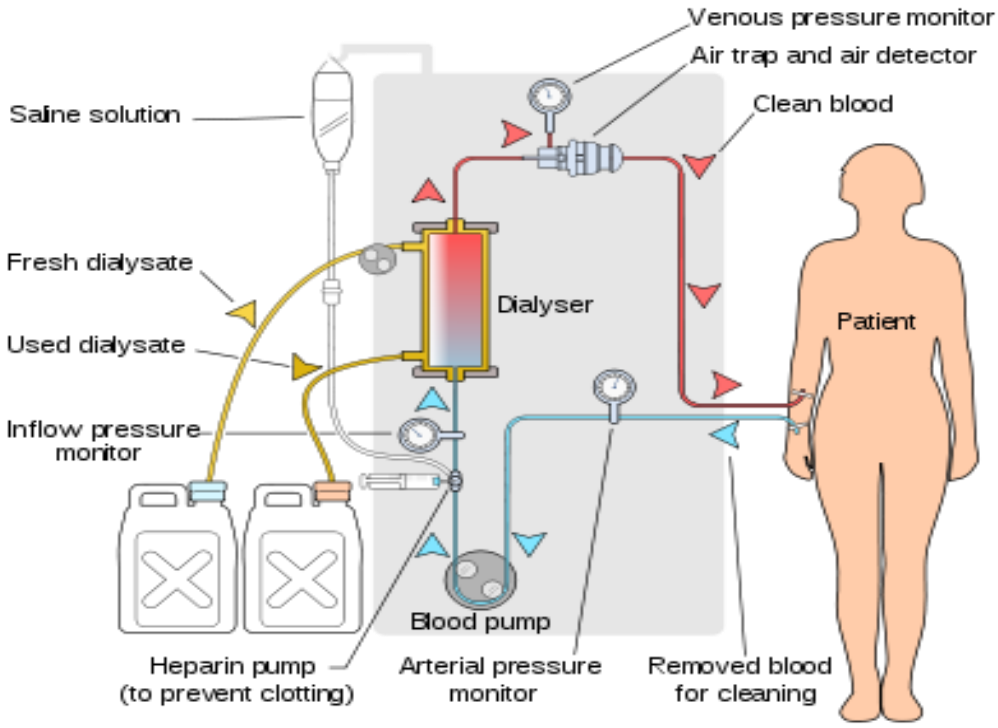

Figure 2: Process of hemodialysis.

*Source: Adapted from Jacobson & Murray pp.243

3. PURPOSE AND STUDY QUESTION

The purpose of this final project was to describe the infection statistics from the year 2007 to 2010 at a surgical hospital in a hemodialysis unit, and to obtain profound knowledge on hemodialysis related infection.

What do the infection rates look like in hemodialysis unit compared to dialysis training center during the years 2007-2010?

4. METHODOLOGY

4.1 Statistical analysis comparison in the years 2007-2010

In this final project, descriptive statistics was applied as a methodology for describing quantitatively the infection statistics of the data we had collected in the hospital. Infections were reported according to hospital regulations. In the hospital, SAI-system /Sairaalan Antibiootti- ja Infektio järjestelmä) is used. As stated in the manual for using SAI-system (Neotide 2009), it allows for better tracking of infections and the treatments used and the efficiency of the treatments used, so that patterns for resistant bacteria can be identified. Nurses use this Windows-based client/server system to report every infection in the ward. On reporting the infection the nurse must register information such as patients' date of intake, social security number, name, gender, age, diagnosis, ward, surgeries and antibiotic therapies. Some of this information the system is able to collect from previous data but sometimes this needs to be manually written.

4.2 Data collection

The main data for the project was collected in the Helsinki university surgical hospital. The date describes the infection statistics at a hemodialysis unit from the year 2007 to 2010.

4.3 Data analysis

In this descriptive analysis of quantitative data, the main finding of the data was analyzed by using the statistical analysis software, SPSS (Statistical package for the social sciences).

5. FINDINGS

The findings of our preliminary work has been given in the following tables and then analyzed in figures 3 and 4 according to the steps below.

Step 1:

This step shows the incidence of infections when the project started and ended during the years 2007 and 2010.

Looking back at the infection statistics in the year 2007, when the joint project for improving hand hygiene and asepsis was started between HUCH Surgical Hospital and Metropolia University of Applied Sciences, we were able to see that the total number of infections was 39. From this, 6 infections were reported in the training center, whereas 33 were in the dialysis ward. The training center has a low incidence of infections. However, the highest number of infections was reported in chronic dialysis patient blood culture positive (71A) which was 3. Pneumonia (41), hemodialysis (HD) patient fistula infection (52A) and HD cannula local infection (52B) all were 1 in the year 2007.

Similarly in the dialysis ward the infection rate in chronic dialysis patient blood culture positive (71A) were 13, HD patient fistula infection (52A) was 4, HD cannula local infection (52B) was 11 and pneumonia (41) was 1. Other infections were PD patient catheter root infection (52C) , dermatological and subcutaneous infection (53Z) ,acute dialysis patient blood culture positive (71B) and clinical sepsis (72) which all were 1. From these infection statistics, we could see that chronic dialysis patient blood culture positive (71A) was the main cause of infection, which accounts the total infection rates of 16 out of 39. The next was the HD cannula local infection (52B) with a total infection rate of 12.

In the year 2010, the total number of infections were 26, with 6 infections in the training center and 20 in the dialysis ward. In the training center the infections rate were described as HD patient fistula infection (52A) was 2, HD cannula local infection (52B) was 1 and chronic dialysis patient blood culture positive (71A) was 3. Besides, the infection rates in the dialysis ward were also described as clostridium difficile (31C) was 1, HD cannula local infection (52B) was 3 and chronic dialysis patient blood culture positive (71A) was 16.

Table 1. Infection statistics at hemodialysis unit of Helsinki University, surgical hospital in the 2007.

Department	Infection group	Infection rate
8707 Nephrology Dialysis Ward	41 Pneumonia	1
	52A HD patient fistula infection	4
	52B HD cannula local infection	11
	52C PD patient catheter root infection	1
	53Z Dermatological and subcutaneous infection	1
	71A Chronic dialysis patient blood culture positive	13
	71B Acute dialysis patient blood culture positive	1
	72 Clinical sepsis	1
8739 Nephrology Dialysis training ward	41 Pneumonia	1
	52A HD patient fistula infection	1
	52B HD cannula local infection	1
	71A Chronic dialysis patient blood culture positive	3
		Sum= 39

Table 2. Infection statistics at hemodialysis unit of Helsinki university, surgical hospital in the 2010.

Department	Infection group	Infection rate
8707 Nephrology Dialysis Ward	31C Clostridium difficile	1
	52B HD cannula local infection	3
	71A Chronic dialysis patient blood culture positive	16
8739 Nephrology Dialysis training ward	52A HD patient fistula infection	2
	52B HD cannula local infection	1
	71A Chronic dialysis patient blood culture positive	3
		Sum= 26

Step 2:

In this step, comparison of infection statistics between the wards was applied for the year the project started and ended.

While comparing the beginning and end of the joint project for improving hand hygiene and asepsis, and also looking at the distribution of the infection rates, we could see a drop down of total infection rates from 39 in the dialysis ward to 26 in the training center. Moreover, the infections group also decreased from 8 to 4 in 2007and 2010 respectively.

By observing these two years (2007 and 2010) when the project started and ended, we were able to conclude that the project has improved aseptic techniques and it can be clearly seen in the infection statistics comparison. Both the infection rates and the infections group significantly decreased.

Step 3:

In this stage, the infections trends for the years 2007 to 2010 described in the table 3, figure 3 and 4 below.

As it is indicated in the figure 3 below; during the four years the number of chronic dialysis patient blood culture positive (71A) is very high. It was the highest in 2010 followed by 2008. The number of cases was also high in 2007, but the lowest in 2009. One problem of the hospital infections was the cases of HD Cannula local infection (52B); in this case the problem was at the highest level in 2007; followed by 2009 and then 2010. The lowest number of the cases was in 2008. In 2007, the HD patient fistula infection (52A) was the highest; but in the other three years, the cases were almost none with few cases in 2008. The remaining number of cases of infection rate was very low in 2007, 2008, and 2010, except that the number of infection of Clostridium difficile (31C) was the highest in 2009.

Again, as it was indicated in the figure 4 below; during the four years the number of chronic dialysis patient blood culture positive (71A) was very high. It was the highest in 2009, which was followed by the cases in 2008. The cases were relatively low in the years 2007 and 2010. Another problem of the hospital infections was again the cases of HD Cannula local infection (52B); in this case the problem was at the highest level in 2009; followed by 2008. The cases of HD Cannula local infection were very low both in 2007 and 2010. Another problem HD patient fistula infection (52A) which was the higher in both 2009 and 2010 as compared to the lower case in 2007 and 2008; but only few cases of pneumonia (41) were reported in 2007 and 2008, which were both none in 2009 and 2010. Sepsis blood culture positive (71) was only reported in 2008.

Table 3. Infection statistics at hemodialysis unit of Helsinki University, surgical hospital during the years 2007-2010.

Infection group	2007	2008	2009	2010
31C Clostridium difficile		1	3	1
41 Pneumonia	2	3	0	0
52A HD patient fistula infection.	5	2	2	2
52B HD cannula local infection	12	3	11	4
52C PD patient catheter root infection	1	0	0	0
53Z Dermatological and subcutaneous infection	1	0	0	0
71A Chronic dialysis patient blood culture positive	16	21	22	19
71B Acute dialysis patient blood culture positive	1	0	0	0
72 Clinical sepsis	1	0	1	0
71 Sepsis: blood culture positive	0	1	0	0
SUM = DIALYSIS WARD + TRAINING CENTER	39	31	39	26

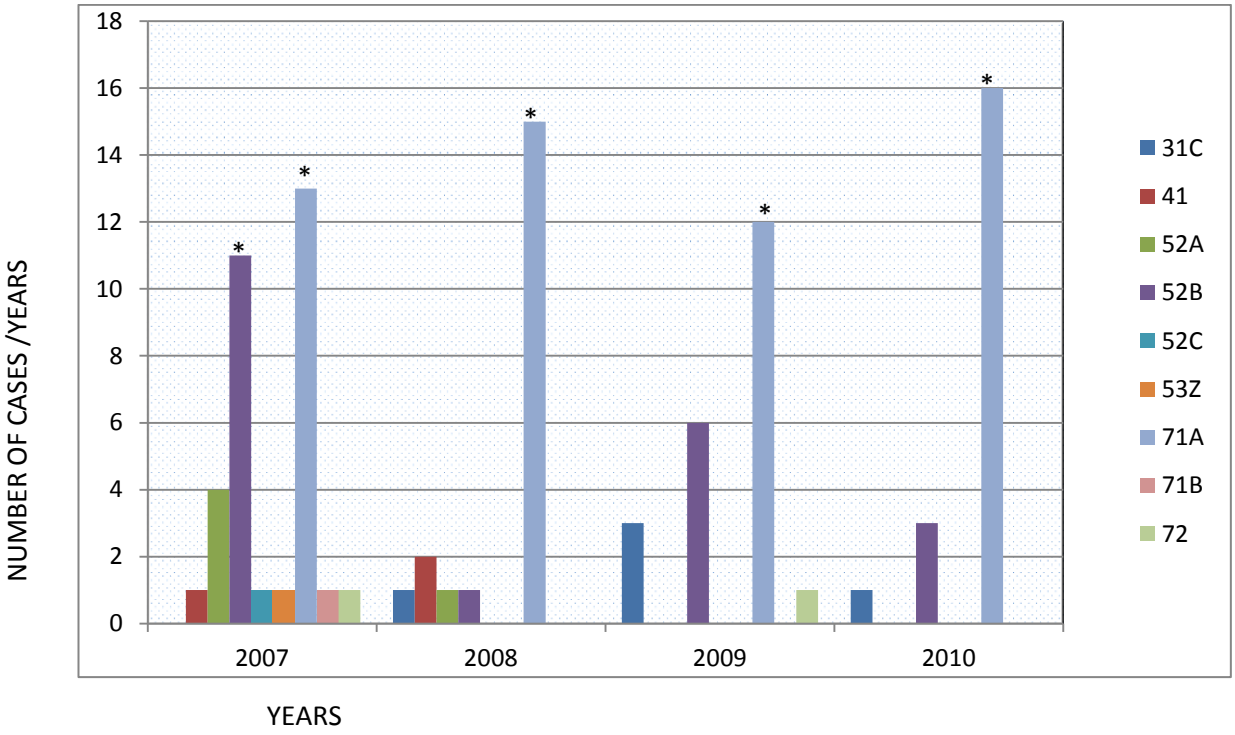

Figure 3: Infection pattern at Nephrology dialysis ward (8707) of HUS, surgical hospital. The bar graphs represent number of infection cases in a particular year from 2007 to 2010; the infections included are clostridium difficile(31C), pneumonia(41), hemodialysis patient fistula infection(52A), hemodialysis cannula local infection(52B), peritoneal dialysis catheter root infection(52C), dermatological and subcutaneous infection(53Z), chronic dialysis patient blood culture positive(71A), acute dialysis patient blood culture positive(71B) and clinical sepsis(72).

*Source: Adapted from HUCH (HUS), surgical hospital.

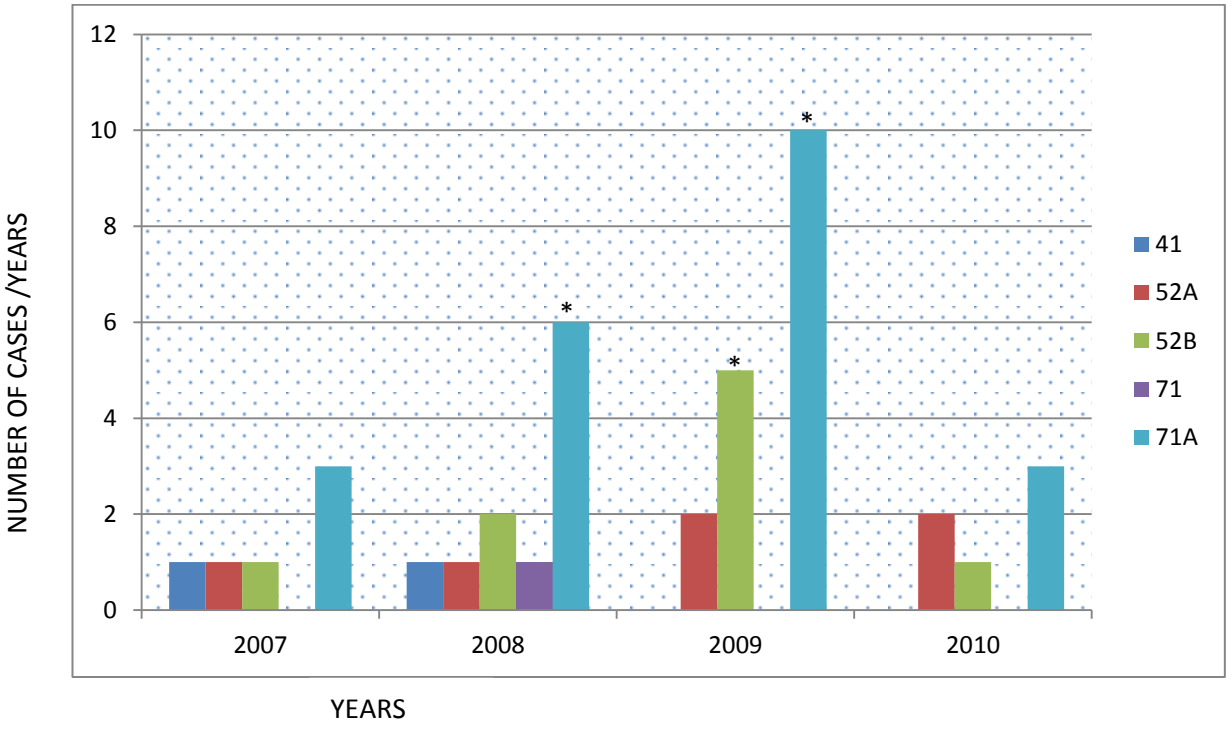

Figure 4: Infection pattern at Nephrology dialysis training center (8739) of HUS, surgical hospital. The bar graphs represent number of infection cases in a particular year from 2007 to 2010; the infections included are clostridium difficile(41), hemodialysis patient fistula infection(52A), hemodialysis cannula local infection(52B), sepsis blood culture positive(71) and chronic dialysis patient blood culture positive(71A).

*Source: Adapted from HUCH (HUS), surgical hospital.

6. DISCUSSION

6.1 Ethical considerations

Ethical research is essential to generate sound knowledge for practice. Conducting research ethically starts with the identification of the project topic and continues through the publication of the project. The ethical actions essential in research includes protection of the participants rights, obtaining permissions and submitting a research proposal for institutional review. (Burns & Grove 2005.)

The ethical considerations regarding this project were related to the statistical data we had collected from the hospital. Confidentiality was guaranteed, as there was no requirement to access patient records. Permission for this project was granted by Nephrology Clinic of HUCH Surgical Hospital. Besides, the articles used do not reveal any detailed personal information like patients' gender, ethnical background or age. The sources and references for each data used are cited after the sentence or paragraph. This paper has also followed the Metropolia's guidelines for writing final projects.

6.2 Reliability and validity

Reliability of data is connected to consistency, accuracy, precision, stability, equivalence, and homogeneity. A reliable item or instrument is required to be consistent. Validity is the quality of research being used to support the argument being made. It also refers to if a measurement instruments measures accurately as it is supposed to measure. (Lo-Biondo-Wood & Haber 2006.)

Content validity was predefined and serves as the basis for the framework of our project as we didn't question the accuracy of the data we analyzed. Consistency of the data was defined through critical examination of the methods and the instruments used upon describing the data. We reviewed the data with accuracy and used the appropriate method to describe. Internal validity was prominent in our work, and the external validity is trusted upon a third party which we find to be reliable.

The data collected from the hospital and the articles used in this project went through monitoring procedures before they were published hence the validity is assured.
In this final thesis writing we kept in mind that all the findings were based on the articles we had read and the statistical data we had collected from the hospital, our personal views were not added. Thus, we analyzed our data according to the study question and our topic.

6.3 Discussion according to the findings

The results of this study has generally summarized in the figures 3 and 4 above; and our observation of the situations of the infection patterns at nephrology dialysis ward of HUS, surgical hospital shows very high chronic dialysis patient blood culture positive. For example, the highest case was in 2010 that was followed by the cases of the same problem in 2008. This problem had been observed consistently since 2007, but the problems seemed lowest in 2009. However, the cases of HD Cannula local infection were the highest level in 2007. From figure 3, one can generalize that the significant infection problems of the hospital were chronic dialysis patient blood culture positive and HD Cannula local infections. Other than few cases, the remaining infections that we considered in this study were more or less insignificant.

Similarly, as we tried to indicate on figure 4; in the training center, there were very high chronic dialysis patient blood culture positive cases during the four years; because, it was given to be the highest in 2009, that followed by 2008. Interestingly, the cases were relatively lower in the years 2007 and 2010. The cases of HD Cannula local infection was the other problem of the hospital infections as it was in the highest level in 2009. Generally, we can say the leading problems were the chronic dialysis patient blood culture positive cases and the HD Cannula local infections; which were relatively significant. However, the rest of the infections that we considered in this study were relatively insignificant (figure 4).

Finally, as we proposed we determined the common and possible infection agents as important risk factors in the haemodialysis unit of the haemodialysis unit of Helsinki University surgical hospital. Thus, this work could be an interesting preliminary work for subsequent and more organized investigations in the hospital. Regardless of several problems we encountered during the study, our data showed important patterns of the

infections. That helped us to recommend further explorations or comprehensive investigations to answer especially why some infections were increased or others decreased during the four years period.

7. CONCLUSION

As it has clearly given in the results, if we compare the general overview of the number of cases, the major problems seemed more in the Nephrology dialysis ward (8707) of HUS, surgical hospital than the dialysis training center (8739) of HUS, surgical hospital. Thus, more infection control measures should be taken into account to minimize the transmission of bacteria, virus or disease. As we have observed from the graphs, the patients in the hemodialysis center seem to be more susceptible to infections compared to the dialysis training center. This study confirmed that enhanced precautions should be taken in the hemodialysis ward to change the patterns of the infection problems in the hospital.

REFERENCES

Aslam, N., Bernardini, J., Fried, L., Burr, R., and Piraino, B. (2006) Comparison of Infectious complications between Incident Hemodialysis and Peritoneal Dialysis Patients. Clin J Am Soc Nephrol 1: 1226-1233, 2006.

Bonner, A. and Walker, A. (2003) Nephrology nursing: blurring the boundaries: the reality of expert practice. *Journal of Clinical Nursing* 13 (2), 210-218.

Boyce, J. & Pittet, D. 2002. Guideline for Hand Hygiene in Health-Care Settings. www.cdc.gov. October 25,2002 Volume 51(RR16); 1-44. Cited and read 28.10.2011.

Bakke, C. (2010) Clinical and cost effectiveness of guidelines to prevent intravascular catheter-related infections in patients on hemodialysis. *Nephrology Nursing Journal* 37(6), 601-616.

Birchenough, E., Moore, C., Stevens, K., & Stewart, S. (2010). Buttonhole cannulation in adult patients on hemodialysis: An increased risk of infection? *Nephrology Nursing Journal* 37(5), 491-499, 555.

Berns, J. & Tokars, J. (2002) Preventing Bacterial Infections and Antimicrobial resistance in Dialysis Patients. *American Journal of Kidney Diseases* 40(5), 886-898.

Coffin, S. E. and Zaoutis, T. E (2005) Infection Control, Hospital Epidemiology. and Patient Safety. Infect Dis Clin N Am 19 (2005) 647-665.

Duval, L. (2010). Infection control 101. *Nephrology Nursing Journal, 37*(5), 485-489.

Finne, P. and Jukkara, R. (2008) Finnish Registry for Kidney Diseases – Report 2008. Finnish Registry for Kidney Diseases.

Gillespie, S. and Bamford, k. (2000) Medical Microbiology and Infection at a Glance. London: Blackwell Science.

Ingram, P. & Murdoch, M. (2009) Aseptic non-touch technique in intravenous therapy. *Nursing Standard* 24(8), 49-57.

Jacobson,B. & Murray, A. (2007) *Medical Devices: use and safety.* 1st ed. Churchill Livingstone Elsevier.

Kas, G., Podglajen, I., Gueneret, M., Vaupre, S., Bissery, A., Meyer, G. (2005) Microbiological evaluation of two hand hygiene procedures achieved by healthcare workers during routine patient care: a randomized study. Journal of Hospital Infection (2005) 60, 32-39.

Kozier,B., Erb,G., Berman,A. & Snyder,S.(2004) *Fundamentals of Nursing: Concepts, Process, and Practice.* 7th ed. New Jersey: Pearson prentice hall.

Lo-Biondo-Wood, G. and Haber, J. (2006) *Nursing Research: Methods and Critical Appraisal for Evidence-Based Nursing.* 6th ed. Mosby.

National Kidney Foundation. Internet document <www.kidney.org > Read 20.06.2011.

Parker J. (1998) Nephrology nursing as a specialty. In Contemporary nephrology nursing. *American Nephrology Nurses' Association* 13(2), 5–23.

Siegel, J., Rhinehart, E., Jackson, M. & Chiarello, L.(2007) Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare settings 1-225 http://www.cdc.gov/ncidod/dhqp/pdf/isolation2007.pdf. Read 28.07.2011.

Smeltzers, S., Bare, B., Hinkle, J. & Cheever, K. (2008) *Text book of medical-surgical Nursing.* 11th ed. Lippincott: Williams & Wilkins.

Stucke, V. (1993) *Microbiology for Nurses: Applications to patient care.* 7th ed. London: Bailliere Tindall.

Stewart G. & Bonner A. (2000) Competency based standards for advanced practice in nephrology nursing. *European journal of Renal Care Association* 13(2), 50–54.

Tokars, J., Miller, E. & Stein, G. (2002) New national surveillance system for hemodialysis-associated infections: Initial results. *American journal of infection control* 30(5), 288-295.

Tokars,J. & Alter, M. (2001) Preventing Transmissions of Infections among Chronic Hemodialysis Patients. *Nephrology Nursing Journal* 28(5), 537-585.

APPENDIX I

REPORT GENERATOR- Infection rate at Hemodialysis unit in the year 2007

Department	Infection group	Infection rate
8707 Nephrology Dialysis Ward	41 Pneumonia	1
	52A HD patient fistula infection	4
	52B HD cannula local infection	11
	52C PD patient catheter root infection	1
	53Z Dermatological and subcutaneous infection	1
	71A Chronic dialysis patient blood culture positive	13
	71B Acute dialysis patient blood culture positive	1
	72 Clinical sepsis	1
8739 Nephrology Dialysis training ward	41 Pneumonia	1
	52A HD patient fistula infection	1
	52B HD cannula local infection	1
	71A Chronic dialysis patient blood culture positive	3

APPENDIX II

REPORT GENERATOR- Infection rate at hemodialysis unit in the year 2008

Department	Infection group	Infection rate
8707 Nephrology Dialysis Ward	31C Clostridium difficile	1
	41 Pneumonia	2
	52A HD patient fistula infection	1
	52B HD cannula local infection	1
	71A Chronic dialysis patient blood culture positive	15
8739 Nephrology Dialysis training ward	41 Pneumonia	1
	52A HD patient fistula infection	1
	52B HD cannula local infection	2
	71 Sepsis: blood culture positive	1
	71A Chronic dialysis patient blood culture positive	6

APPENDIX III

REPORT GENERATOR- Infection rate at hemodialysis unit in the year 2009

Department	Infection group	Infection rate
8707 Nephrology Dialysis Ward	31C Clostridium difficile	3
	52B HD cannula local infection	6
	71A Chronic dialysis patient blood culture positive	12
	72 Clinical sepsis	1
8739 Nephrology Dialysis training ward	52A HD patient fistula infection	2
	52B HD cannula local infection	5
	71A Chronic dialysis patient blood culture positive	10

APPENDIX IV

REPORT GENERATOR- Infection rate at hemodialysis unit in the year 2010

Department	Infection group	Infection rate
8707 Nephrology Dialysis Ward	31C Clostridium difficile	1
	52B HD cannula local infection	3
	71A Chronic dialysis patient blood culture positive	16
8739 Nephrology Dialysis training ward	52A HD patient fistula infection	2
	52B HD cannula local infection	1
	71A Chronic dialysis patient blood culture positive	3